# POLLUTION

# OF THE

# ST. CLAIR RIVER
# (SARNIA AREA)

A SITUATION REPORT

PREPARED BY

ENVIRONMENT CANADA

AND THE

ONTARIO MINISTRY OF ENVIRONMENT

UNDER THE AUSPICES

OF THE CANADA-ONTARIO AGREEMENT

RESPECTING GREAT LAKES WATER QUALITY

(ENGLISH ONLY)

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# ST. CLAIR RIVER SITUATION REPORT

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# ST. CLAIR RIVER SITUATION REPORT

## A. INTRODUCTION

Dow Chemical's spill of perchloroethylene into the St. Clair River near Sarnia in August 1985 and the occurrence of small "globs", (fist size) of a tarry substance on the river bottom have become a focus of public environmental concern in Ontario. Concern centres on the safety of the drinking water supply drawn from the St. Clair and the extent and source of contamination of the St. Clair River in the Sarnia area. This situation report, compiled by Environment Canada and the Ontario Ministry of Environment; provides a summary of the environmental conditions of the river, past and present pollution control practices in the area; and current government actions.

## B. ENVIRONMENTAL CONDITIONS

### 1. POINT SOURCES - INDUSTRIAL

The "Chemical Valley" at Sarnia is composed of a number of petroleum refineries and petrochemical plants, mostly adjacent to the river, within ten kilometres south of the business core. Table 1 lists the industries in order of location (north to south) and provides a list of products. The facility list represents the bulk of the industry located on the St. Clair River and the area along the shoreline which is most degraded in terms of water and sediment quality. The attached map shows the location of the St. Clair River and Sarnia in southwestern Ontario along with the location of specific facilities identified in the attached table.

These industries discharge a daily total of 1.7 billion litres of process, cooling and storm water (1983 annual average). The Ontario Ministry of the Environment regulates the discharge of conventional pollutants such as suspended solids, metals such as lead, and a limited group of organic contaminants such as total phenols. This is effected by a variety of means such as Control Orders, Certificates of Approval and the use of Ontario's General Industrial Discharge Objectives or Federal Industry Specific Regulations and Guidelines. Control Orders and Certificates of Approval may or may not stipulate actual discharge objectives for specific pollutants. Over the last 20 years, the industries in the area have accomplished major reductions in the discharge of pollutants by installing end-of-pipe treatment such as the installation of bio-oxidation plants at Polysar and the petroleum refineries, modifying manufacturing processes, and recycling wastestreams.

ST. CLAIR RIVER INDUSTRIAL POINT SOURCES[1]

Table

| # | NAME | TYPE | PRODUCTS |
|---|---|---|---|
| 1 | Esso Petroleum Canada | Petroleum Refinery | Gasoline, Stove Oil, Diesel Fuel, Jet Fuel, Home Heating Oil, Lube Oil, Waxes, Asphalt, LPG |
| 2 | Esso Chemical Canada | Petrochemical | PVC, Olefins, Lubricant Additives, Polyethylene Resins, Benzene, Toluene, Xylene |
| 3 | Cabot Carbon | Petrochemical | Carbon Black |
| 4 | Fiberglass Canada | Petrochemical/Inorganic | Glass Fiber Insulation |
| 5 | Polysar Limited | Petrochemical | Synthetic Rubber, Rubber Latex, Benzene, Ethyl Benzene, Styrene, Butadiene, Isobutylene |
| 6 | Dow Chemical Canada | Petrochemical | Styrene, Polystyrene, Propylene Glycol, Chlorine, Caustic Soda, Methychloride, Perchloroethylene, Latexes, Vinyl Chloride, High Density Polyethylene, Polystyrene Foam, Trichloroethane, Other Chlorinated Solvents |
| 7 | Sunoco Inc. | Petroleum Refinery | Gasolines, Kerosene, Jet Fuel, Heating Oils, Aromatics, Sulphur, LPG, Heating Oil |
| 8 | Shell Canada Ltd. | Petroleum Refinery | Gasolines, Aromatic and Aliphatic Solvents, Stove Oil, Diesel Fuel, Home Heating Oil, Bunker Fuel, Fuel Gas, Propane, Butane, Butylenes and Liquid Sulphur |
| 9 | Ethyl Corporation | Petrochemical | Ethyl Chloride, Ethylene Dichloride, Tetraethyl Lead Antiknock Additive, Phenolic Antioxidants, Aluminum Alkyls |
| 10 | Dupont of Canada | Petrochemical | Low to High Grade Polyethylene Resins |
| 11 | Petrosar Limited | Petrochemical Refinery | Ethylene, Propylene, Butadiene, Isobutylene, Butylene, Benzene, Toluene, Gasoline, Fuel Oil, LPG, Synthetic Natural Gas |
| 12 | Union Carbide | Petrochemical | Polyethylene Resins |

[1] Industries south of Corunna not included (CIL-Fertilizers, Ontario Hydro - Coal Fired Generating Station, Chinook Chemicals - Methyamines (seasonal discharge)).

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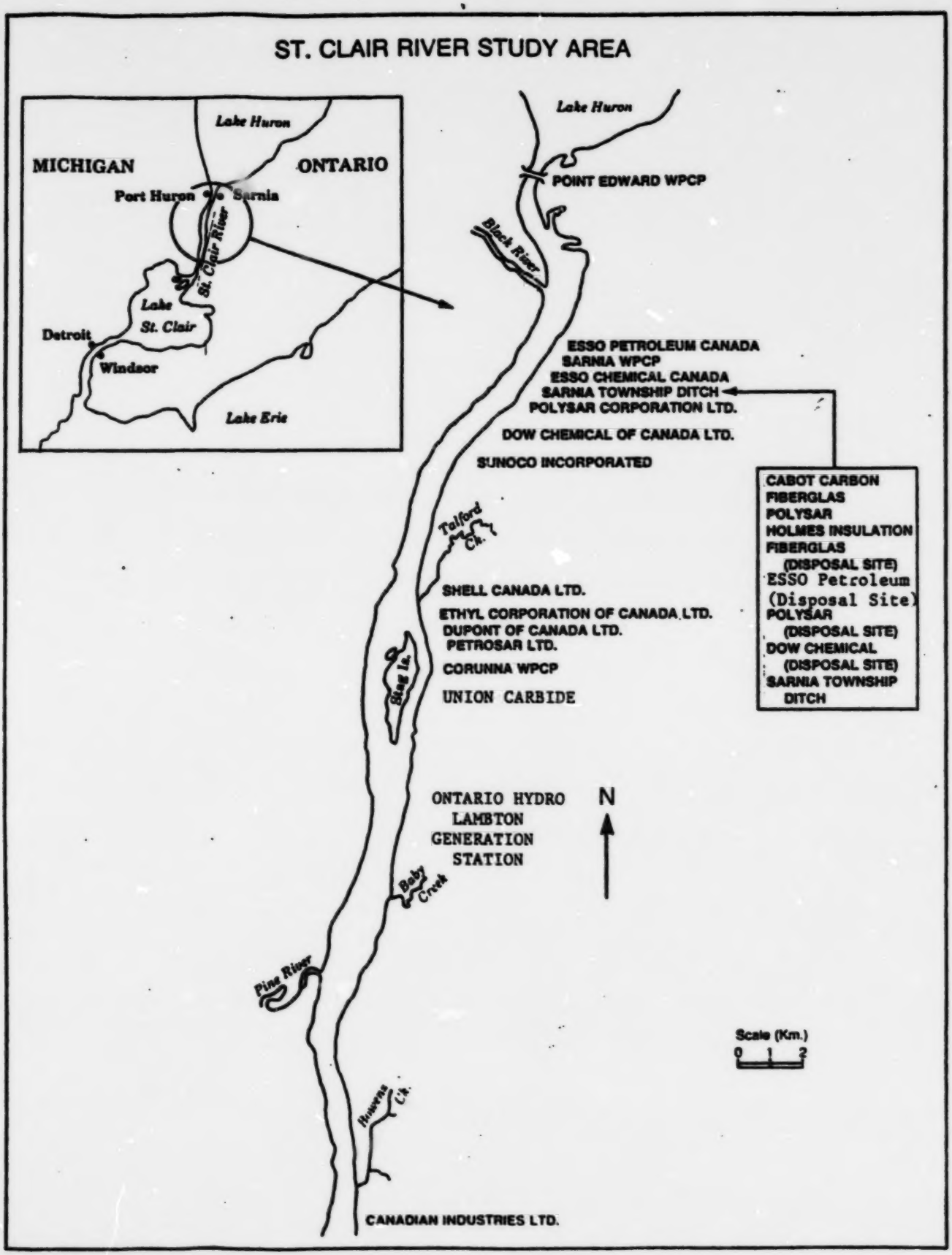

ST. CLAIR RIVER STUDY AREA
Lake Huron
MICHIGAN
ONTARIO
Port Huron
Sarnia
St. Clair River
Lake St. Clair
Detroit
Windsor
Lake Erie
Lake Huron
POINT EDWARD WPCP
Black River
ESSO PETROLEUM CANADA
SARNIA WPCP
ESSO CHEMICAL CANADA
SARNIA TOWNSHIP DITCH
POLYSAR CORPORATION LTD.
DOW CHEMICAL OF CANADA LTD.
SUNOCO INCORPORATED
CABOT CARBON
FIBERGLAS
POLYSAR
HOLMES INSULATION
FIBERGLAS
(DISPOSAL SITE)
ESSO Petroleum
(Disposal Site)
POLYSAR
(DISPOSAL SITE)
DOW CHEMICAL
(DISPOSAL SITE)
SARNIA TOWNSHIP
DITCH
Talford Ck.
SHELL CANADA LTD.
ETHYL CORPORATION OF CANADA LTD.
DUPONT OF CANADA LTD.
PETROSAR LTD.
CORUNNA WPCP
UNION CARBIDE
Stag Is.
ONTARIO HYDRO
LAMBTON
GENERATION
STATION
N
Baby Creek
Pine River
Scale (Km.)
0 1 2
Hawrens Ck.
CANADIAN INDUSTRIES LTD.

During the late 1970's an increased awareness of toxic organic compounds and the laboratory technology for their identification allowed the analysis of these effluents for trace organics (Ontario Ministry of the Environment 1975 and 1977, Environmental Protection Service/Ontario Ministry of the Environment 1979-1980). The results of these studies indicated that some effluents contained very high concentrations of industrial organic pollutants in excess of one part per million (1 ppm). The industries found to be discharging organics in excess of 1 ppm were asked to control the effluent immediately, while those compounds discharged in excess of 0.1 ppm were to be subject to increased monitoring. The present quality of these effluents will be evaluated in detail during 1986 under an EPS - Ontario Region - Ontario Ministry of the Environment cooperative survey of all point sources to the river. This survey will identify sources requiring further remediation and is part of the Canada/U.S. Upper Great Lakes Connecting Channels Study.

In terms of direct discharges to the St. Clair, the Sarnia Township Ditch, which runs through Polysar property is considered as an industrial point source because it contains industrial process effluent and cooling water and treated runoff or leachate from four industrial dumpsites owned by Imperial Oil, Fiberglass, Dow Chemical and Polysar. The Township Ditch may be a major source of organics to the river due to the presence of treated process water (Polysar, Cabot Carbon, Fiberglass) and treated leachate and/or runoff from the industrial dumpsites (collectively known as the Scott Road dump). On one occasion during 1985, storm-induced runoff under high flow conditions was apparently responsible for large increases in concentrations of PCBs, hexachlorobenzene and octochlorostyrenes detected in the Township Ditch, primarily in suspended solids and not in the aqueous phase. An additional, minor discharge is the dewatering effluent from the CN Railway tunnel which is contaminated with gases such as phenolics, chlorides and hydrogen sulphide.

See Appendix 1 for more information concerning Industrial Point Sources.

Point Sources - Municipal

The upper river from Point Edward to Corunna also receives the discharge from three municipal water pollution control plants (WPCPs) - Point Edward, Sarnia and Corunna - which have a combined capacity of 73 million litres per day. The Point Edward and Sarnia WPCPs provide primary treatment with phosphorus removal. The Corunna Plant is an extended aeration facility with phosphorus removal.

In addition to the WPCPs, urban runoff (storm sewers) and combined storm/sanitary waste (combined sewer overflows) also discharge to the river. Sarnia is the major urban centre and has 4 wet weather combined sewer overflows and 11 storm water outfalls. Two of the combined sewer overflows and three of the storm sewers service the "Chemical Valley" and are potential sources of industrial organics.

NON-POINT SOURCES

An indirect yet potentially significant source of contaminants arises from urban and rural runoff and drainage of unknown origin into tributaries.

In a recent study conducted by Agriculture Canada for Environment Canada, it has been reported that about 2.5 million kg of agricultural pesticides are used annually in the agricultural land draining into the Detroit-St. Clair River connecting channels. Approximately 70% of these pesticides have been identified as potentially environmentally hazardous. While documentationn of the use of these agricultural pesticides is complete, the fate of these chemicals in the environment remains unclear. Recent analysis of surface water (Thames River), ground water (drinking wells), and municipal drinking water supplies by provincial authorities have identified high levels of several of the pesticides used extensively in agriculture. Further definitive documentation of this emerging issue is required.

Surveys in 1984 and in 1985 by the Ministry of the Environment have provided estimates of loading contributions from water and suspended solids entering the St. Clair River from adjacent watersheds. In addition to conventional water chemistry parameters, nutrients, phenols, mercury and heavy metals were routinely analyzed.

Additional organic compounds measured, included PCBs, chlorinated aromatics, chlorophenols, herbicides and pesticides.

Typically, 1984 organic contaminant levels under low flow dry weather conditions were below detection levels with some exceptions associated with aqueous fraction as opposed to suspended solids.

Elevated levels were also noted for the pesticides atrazine, Ethion, and Mevinphos in Talford and Baby Creeks. The latter two were detected in July and possibly originate from agricultural land runoff.

## WASTE DISPOSAL SITES

There are eleven waste disposal sites in Lambton County within 3 km of the St. Clair River. This includes 2 landfarming operations for refinery wastes, 7 landfills, 4 settling ponds, and 1 drum storage facility. A tabular summary of the activities of these facilities' is attached. The information provided below applies only to active sites. Those which may have been used historically but are now closed, are not included. An example is the Ladney property which is privately owned and has been covered and seeded.

### Landfarming

Landfarming or landspreading involves the application of petroleum wastes to the upper soil zone where it's decomposed by spoil bacteria. Shell and Esso annually dispose of 18,580 cubic meters of oily wastes and sludges by landfarming. Esso is the major landfarmer disposing of 17,900 cubic meters.

Groundwater and surface water monitoring is conducted at both sites wich are located on clay or till with very low permeability. Impact on these waters is negligible.

### Landfills (Disposal Sites)

Dow, Esso, Polysar, Fiberglass, Ontario Hydro, Unitec and Welland Chemicals Limited operate landfills for industrial waste. The province of Ontario is responsible for licensing these sites. Prior to remediation, leachate from Dow's Scott Road site was migrating into the Scott Road Drain which empties into the St. Clair via the Township Ditch. The site was subsequently bermed for the collection Leachate, which is now treated using activated carbon prior to discharging to the Scott Road Drain. The Scott Road and Township Ditches were subsequently excavated to remove contaminated sediments which were placed in the Dow landfill. Imperial Oil (Esso Petroleum and Esso Chemcial) Fiberglass and Polysay also operate disposal sites along Scott Road. Further sampling of sediments, water, leachate and runoff is necessary to determine whether the disposal sites are a continuing source of organics. Some preliminary sampling will be conducted as part of Environment Canada's intensive six week study.

The waste types being landfilled vary considerably from solvents with chlorinated hydrocarbons at Dow's Scott Road site to coal and fly ash at Ontario Hydro's site.

Monitoring of surface water, runoff and groundwater also varies considerably. Dow has monitored at the Scott Road site since 1980 but does not monitor at its LaSalle Road site. Polysar and Welland Chemicals Limited have monitoring programs but Esso does not. Ontario Hydro monitors only runoff pH from the fly ash site. As part of the Upper Great Lakes Connecting Channels Study, these disposal sites will be assessed to determine the potential impact on groundwater and surface water.

All landfills are located in clay or clay tills with low permeability.

| SITE | WASTE TYPE | ANNUAL QUANTITIES (WT. OR VOL.) | RUNNOFF/LEACHATE COLLECTION | MONITORING | COMMENTS |
|---|---|---|---|---|---|
| Dow-Scott Road (1948) LANDFILL | - oily sludges, solvents with chlorinated H.C. (esp. hexachlorobutadiene)<br>- contaminated soil. | - 1,000 T | Yes | Surface and ground water since 1980 | - on clay till<br>- sheet pile curtain (2"-15') below grade |
| ESSO-Scott Road LANDFILL | - refinery coke, spent catalysts, constructional and demolition debris | - 11,000 T coke and catalysts<br>- 45,000 T of debris | None | None | - on clay till with low permeability (conductivity $10^{-8}$cm/sec) |
| Polysar-Scott Road LANDFILL | - inert sludges, plastic resins and alkali, inorganic and rubber wastes | - 25,000 $m^3$ | - lagoons for runoff and waste leachate | Surface waters for:<br>- pH<br>- TOC<br>- phenols<br>- copper<br>- ammonia | - capped with fly ash or clay<br>- continuous composite or batch sampling<br>- silty clay till conductivity $8x10^{-8}$ to $3x10^{-7}$ cm/sec<br>- dissolved org. carbon and phenols in ground water near site |
| Dow-La Salle Road LANDFILL | - latex solids, graphite, gycol filter cake, alkali sludges, bi-ox sludges, chemical fertilizer wastes, plant and animal wastes and some toxic wastes | - 22,800 T solid<br>- 8,900 $m^3$ liquid | - proposed (berms) ditches, runoff pond) | None | - clay capping |

CHART/3324

| SITE | WASTE TYPE | ANNUAL QUANTITIES (WT. OR VOL.) | RUNNOFF/LEACHATE COLLECTION | MONITORING | COMMENTS |
|---|---|---|---|---|---|
| Ontario Hydro (Courtright)<br>LANDFILL | - coal ash | - 28,000 T | | None | - silty clay till (50-60% clay) 40m thick |
| | - fly ash | | runoff collection ditches | pH of runoff | - above ground |
| Unitec Inc. (1974)<br>LANDFILL | - rockwool, phenol formaldehyde resin, fibreglass | - 19,000 T | - runoff and leachate collected in lagoon<br>- spray irrigation | Unknown | - individual cells<br>- 4m brown clay<br>- 30m gray clay |
| Shell (1950)<br>POND | - spent lime (to settling pond) | - Nil | | None | - wastes no longer to pond<br>- clay till (21m thick) |
| Shell L-16<br>LANDFARM | - bio sludge and oil waste | - 680 $m^3$ | - runoff collection<br>- till drainage system | Adequate ground and suface water | - clay<br>- 10 cm/year ground water velocity |

CHART/3324.1

| SITE | WASTE TYPE | ANNUAL QUANTITIES (WT. OR VOL.) | RUNNOFF/LEACHATE COLLECTION | MONITORING | COMMENTS |
|---|---|---|---|---|---|
| ESSO<br>LANDFARM | - refinery waste<br>- lime sludges, anaerobically digested activated sludges oil sludges | - 17,900 $m^3$ | | Ground water and surface water done but not documented | - till (low conductivity) |
| CIL (Courtright)<br>PONDS | - low level radioative (limited quantity) radium and uranium in waste gypsum slurry<br>- ponds with clay dykes | | - drainage ditches | Surface water and ground water | |
| Welland Chemicals Ltd.<br>LANDFILL<br>POND<br>DRUM STORAGE | - drum storage, liquid effluent storage pond<br>- anhyorous aluminum chloride landfilled in drums | | - perimeter ditches (into Talfour Creek) result in leachate irrigration | Some sampling done<br>- surface water<br>- ground water<br>- runoff | - discharge from treatment lagoons to Scott Road drain<br>- 3-5m brown clay 30m of gray till |
| | | | | | |

CHART/3324.2

Ponds

Shell, CIL and Welland Chemical have ponds for the treatment or storage of their wastes. The Shell settling pond for spent lime slurries is no longer used; CIL operates two ponds for gypsum slurry waste and Welland Chemical operates a liquid effluent storage pond, as well as a lagoon waste treatment system which discharges to the St. Clair River via the Scott Road Drain.

Surface water and groundwater monitoring to identify pond seepage is done at CIL and Welland Chemical Limited.

Drum Storage

Welland Chemical Limited operate a drummed storage facility.

Waste Disposal Summary

1. The types of waste disposal practices near the St. Clair River include landfarming, landfilling of hazardous and non-hazardous waste, pond storage, lagoon treatment, and drum storage.

2. Monitoring of surface and groundwater sources varies considerably.

3. Soil permeability beneath the sites is low, therefore migration of contaminants through the soil from surface and near surface waste sources is slow.

SPILL SUMMARY

During the years 1972 to 1984, there were 275 spills reported in the Sarnia area. In 161 cases, or 58% of the spills, some product entered the St. Clair River, or its tributaries.

Companies with the highest frequency spills:

| | |
|---|---|
| Polysar | 48 spills |
| Dow Chemical | 29 " |
| Imperial Oil/Esso | 37 " |
| CNR | 11 " |
| Sun Oil | 13 " |

During the 12 year period the most significant spills included the following products:

| Product Spills | # Spills | Total Volume |
|---|---|---|
| Oil | 40 | 1,000 metric tons |
| Acid | 11 | 155 " " |
| Paint | 10 | 59 " " |
| Phenol | 9 | 7 " " |
| Styrene | 7 | 16 " " |
| Sodium hydroxide | 4 | 84 " " |
| Vinyl chloride | 3 | 23 " " |
| Xylene | 2 | 11 " " |
| Benzene | 2 | 0.5 " " |

The remaining 187 records include releases of bilge water, sludges, process water, carbon black and other undefined mixtures.

Contingency Plans

Several contingency plans for spills are established. The Ontario Ministry of the Environment, Canadian Coast Guard and Environment Canada all have contingency plans in place to deal with spills of oil and hazardous materials. There are also agreements between the 3 agencies to provide support to each other at the request of the lead agency. The responsibility for the lead role is divided between DOE, MOE and CCG.

DOE is responsible for spills from federal facilities and also becomes involved when a spill impacts federal property, such as Walpole Island in the St. Clair River.

MOE has jurisdiction over all other land based pollution incidents.

CCG is the lead agency for Marine spills and in cases where the international boundary is affected.

International Spills

Annex 9 of the Great Lakes Water Quality Agreement gives the Canadian and U.S. Coast Guards responsibility for the Canada/United States Joint Marine Pollution Contingency Plan for Spills of Oil and other Noxious Substances. Notification procedures are established and members of a Joint Response Team are identified, to deal with major international spills.

Although the Joint Plan has been used to notify the Canadian and U.S. agencies of major incidents such as the recent perchloroethylene spill, it has not been necessary to invoke the plan in the Sarnia area.

A detailed supplement to the joint plant for the Detroit-St. Clair River System has been prepared to identify local concerns and resources.

Summary of Spills in St. Clair River in excess of 40 metric tonnes.

1- Ship named "Parkerevans" collision, 210 MT of Bunker "C" spilled on Juin 5, 1972 in St.Clair River. 90% recovered.

2- Overflow at "Polysar" of 159 MT of industrial waste (lignliquor) spilled on Juin 23, 1975 on land & water. 90% recovered.

3- Pipe leak at "Imperial Oil Ltd", 239 MT of Phenol waste water spilled on July 22, 1975 in St. Clair River. 0% recovered.

4- Pipe leak at "Sun Oil", 150 MT of Bunker "C" spilled on January 28, 1976 in St. Clair River. 90% recovered.

5- Plant upset at "Polysar", 86.5 MT of Latex rubber spilled in St. Clair River on January 30, 1980. 0% recovered.

6- Dyke failure at "Dow Chemical", 4,079 MT of Sodium chlorate spilled in St. Clair River on November 21, 1979. Under 30% recovered.

7- Fitting failure at "CN-Rail", 85.7 MT of Bunker "C" spilled on July 6, 1977 on land. 90% recovered.

8- Overflow at "Polysar", 411.2 MT of Styrene spilled on St. Clair River on May 20,1978. 90% recovered.

9- Pipe leak at "Imperial Oil", 348 MT of Gasoline spilled on land on December 26, 1981. 100% recovered.

10- Pipe Leak at "Dow chemical", 379 MT of sodium chloride spilled in St. Clair River on December 22, 1981. 90% recovered.

11- Dyke failure at "SUNOIL", 91 MT of process water spilled in St. Clair River on December 18, 1975. Under 30% recovered.

12- Pipe Leak at "SUNOIL", 300 MT of Bunker "C" spilled on land in St. Clair River area on January 29, 1976. 100% recovered.

13- Overflow at "Esso Petroleum", 45.5 MT of washwater spilled to the St. Clair River area on September 7, 1982. 0% recovered.

14- Pipe Leak at "Esso", 164 MT of salt water "brine" spilled on ground on January 8, 1984. 90% recovered.

15- Fitting failure at "Esso", 116 MT of fuel #2 spilled in St. Clair River on February 22, 1984. 90% recovered.

## 2. DEEP WELL INJECTION PRACTICES

### INTRODUCTION

Deep well waste disposal is the injection of a liquid waste, under pressure or by gravity, into a porous geological strata. Upward migration from the disposal zone, potentially resulting in ground water or surface water contamination, will occur if the confining beds contain natural permeable channelways, such as faults and fractures, and if hydraulic pressures are sufficient. Injection pressures, if high enough, can fracture the overlying formations. Abandoned, poorly constructed and improperly plugged boreholes may also aid upward migration.

From 1958 to 1976, disposal wells discharged about $8 \times 10^6$ $m^3$ of industrial wastes at pressures up to 450 psi into the Detroit River Group in the Sarnia area. These activities were terminated as a result of breakouts of brine and wastes at the surface. The types of waste injected were primarily spent caustics, acids, phenols, hydrocarbons, and brines (see attached Tables).

Since 1976, provincial authorities have allowed gravity disposal of wastes (cavern washing and oil field brines) five miles away from the river. The deep well operations were approved by the Ministry of Natural Resources and operators were required to submit monthly reports on injection volumes to the Ministry of the Environment (OWRC).

### Geology and Hydrogeology of Lambton Co. in the Vicinity of Sarnia

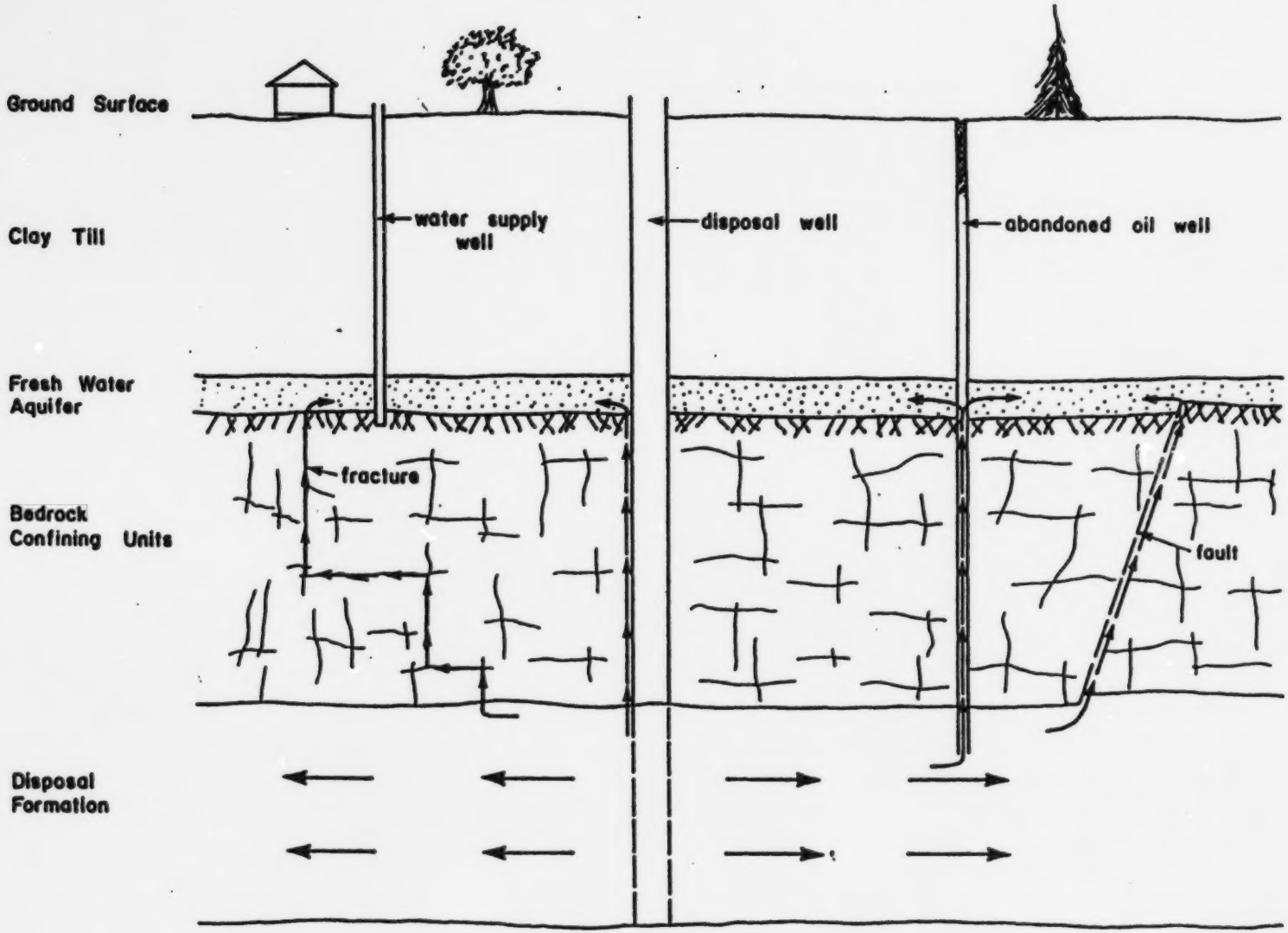
A vertical 'section' cut through the ground in this area would display, beginning at the top: 30 to 50 meters of clay (lake and glacial deposits) overlying bedrock consisting primarily of shale (Lambton and Hamilton groups) over limestone and dolomite (Detroit River Group), over limestone, shale and salt ('Salina Formation', see attached diagram). Sand and gravel occurs between the clay and upper shale; groundwater within this zone constitutes the primary source of well water in the area. This zone is referred to as the 'freshwater aquifer'.

Oil and gas deposits occur at various depths within the rock units. Wells drilled into these rocks for exploration and production over the last 100 years have resulted in an abundance of abandoned and often improperly plugged oil and gas wells.

The ideal concept of deep well injection of wastes is to place the material at sufficient depths and under 'confining' rock units (such as shale) which will prevent their subsequent entry into the ecosystem. However, the 'Detroit River Group', into which most of the wastes were injected, does not fully meet the generally accepted criteria applied to disposal zones and confining beds. Unknown, abandoned wells, natural fractures (joints and faults) and, possibly caves, as well as man-induced fractures (from pressure injection of the wastes) all provide potential channels for the wastes to move up into the freshwater aquifer.

More recent data from groundwater and gas monitoring in the CN railway tunnel could indicate that waste disposed in the Detroit River Group may have entered the freshwater aquifer. In addition, temporal variations of chloride concentrations and the composition of gases entering the tunnel suggest that the operation of gas caverns in the Salina Formation influences movement of contaminants within and above the Detroit River Group. This is an area which will require further investigation.

Although industrial disposal operations have ceased, salt mine wastes and oil field brines have continually been disposed in the Detroit River Group. These activities, along with residual pressures in the Detroit River and possibly, the storage of gas and propane in salt caverns, may result in the migration of pollutants from the deep wells upward into the freshwater aquifer and subsequently into the river.




Schematic of possible failure pathways for migration of contaminants from the disposal zone to the fresh water aquifer

Location of Wells

There were 16 injection wells which received liquid industrial wastes. These extend approximately 205 meters (600 feet) below ground surface into the Detroit River Group limestone formation under pressures of 0 to 450 psi. In addition, Dow Chemical operated two storage caverns at a depth of 580 meters (1900 feet) under gravity feed into the Salina (salt) formation. A map of the well locations is attached.

Substances and Quantities Disposed

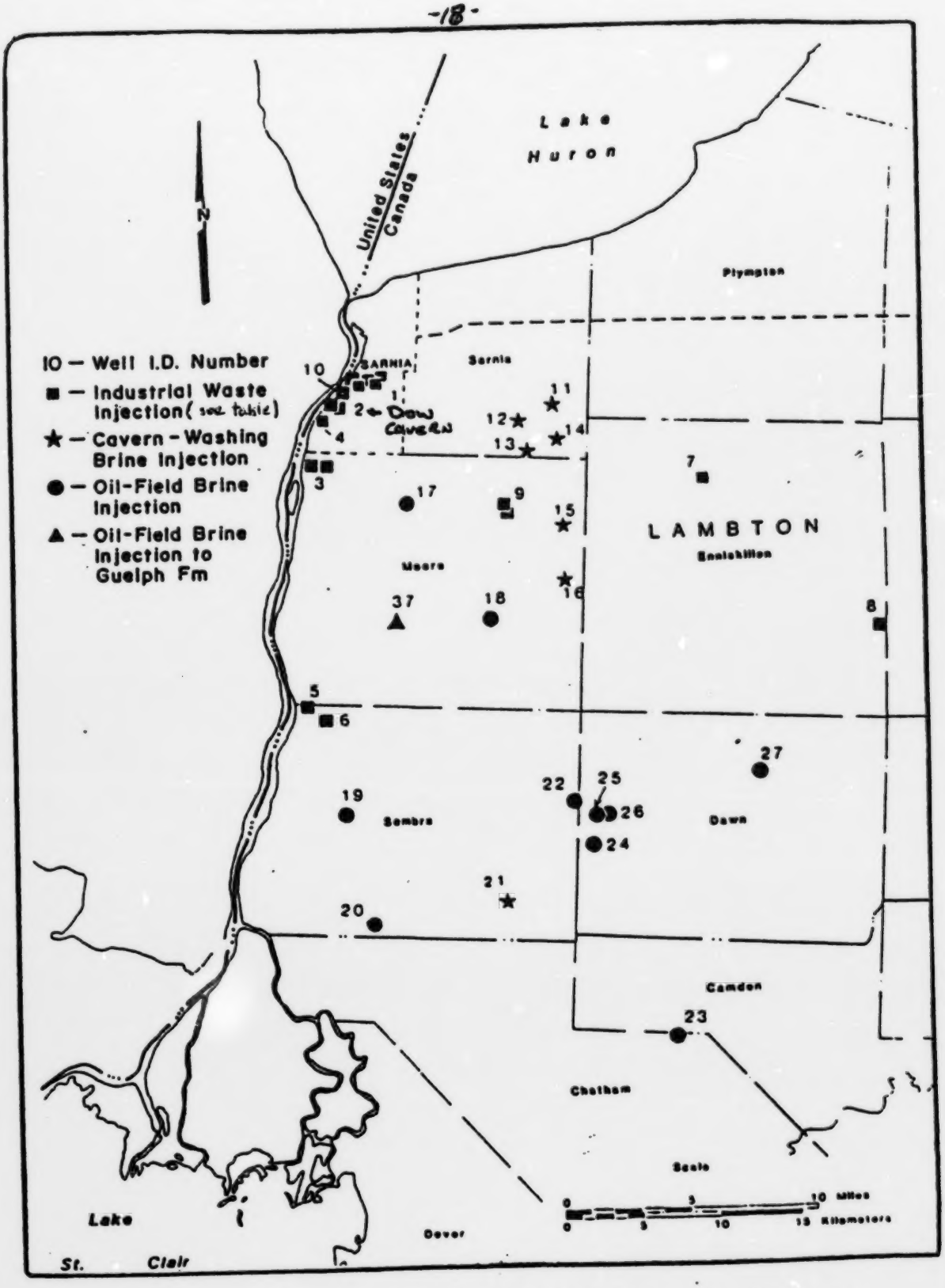
See attached table.

Previous Upwelling

There is historical documentation to suggest that pressurized waste has migrated from the Detroit River Group formation resulting in the flowing of industrial wastes from abandoned wells in both Lambton County and Port Huron Michigan areas. In 1967, several abandoned wells in Port Huron, Michigan began to flow, yielding water containing phenols and hydrogen sulphide. In 1972, an abandoned 44m (140 ft.) well behind the Capitol Theatre in Sarnia began to flow. The greenish liquid contained high levels of phenol, chloride, hydrogen sulphide and organic carbon. In the same year, 2 water wells on the Imperial Oil Ltd. property began to discharge similar-type liquids. Deep well disposal of such waste was subsequently discontinued, however, deep well disposal of brine wastes continues.

| Company Well Name | Map I.D. No. | Location | | | | Well Head Elevation Feet (Meters) | Total Depth Feet (Meters) | Injection Zone Interval Feet (Meters) | Maximum Well-Head Pressure psi (KPa) | Average Injection Rate bbls/day ($m^3$/day) | Period of Injection | Total Injected bbls ($m^3$) | Major Type of Waste |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | County | TWP | Conc. | Lot | | | | | | | | |
| Marcus Disposal Well #1 | 8 | Lambton | Enniskillen | S | 31 | 675 (206) | 961 (293) | Detroit River Gr. 488'-689' (149-210) 545-580 (166-177) | 0 to 150 (1034) | 740 (118) | 1970-1971 | 270,000 (42,927) | Spent Caustic Industrial Waste |
| Thompson Right Company 2 Wells | 7A | | | 12 | 12 | 670 (204) | 852 (260) | 550 - 852 (168-260) | 50 | 118 (18.8) | 1965-74 | 490,000 (77,900) | Acid Caustic Brine Oily Water |
| | 7B | | | | | 673 (205) | 1000 (305) | | 50 | | 1969-74 | | |
| Tricil #1 Goudreau 2 Wells #2 | 9A | Lambton | Moore | 10 | 9 | 664 (202) | 597 (182) | | 0 | 300 (47.7) | 1958-1973 | 1,979,000 (314,636) | Hydrocarbons Chlorides Ethers Phenols |
| | 9B | | | 10 | 9 | 663.4 (202) | 700 (213) | 573 - 700 (175-213) | 0 | ? | 1973-1976 | | |
| Shell #1 Canada Limited #2 | 3A | | | Front | 68 | | 950 (290) | 600 - 900 (183-274) | 330 (2275) | 1500 (238) | 1962-1972 | 6,260,000 (995,260) | Phenols |
| | 3B | | | Front | 68 | | 950 (290) | 650 - 950 (198-290) | | | Not utilized | | |
| Sun Oil Company | 4 | Lambton | Sarnia | R.R. | 19 | | 964 (294) | 675 - 964 (206-294) | 300 (2068) | 1900 | 1966-1973 | 3,450,000 (548,506) | Spent Caustic |
| Polymer Corporation | 10 | | | Reg. Plan 12 | 35 | | 900 (274) | | 450 (3103) | 213 (302) | 1961-1970 | 700,000 (111,291) | Spent Caustic Phenols |
| Imperial Oil Limited 5 Wells #2 | 1A | | | | | | 800 (244) | 605 - 800 (184-244) | | 1200 (191) | 1958-1967 | 47,308,330 (7,521,424) | Spent Caustic Phenols Sulfides |
| | 1B | | | | | | 820 (250) | 605 - 820 (184-250) | | 1200 (191) | 1960-1967 | | |
| #3 | 1C | | | | | | 675 (206) | 629 - 675 (192-206) | 400-450 (2758-3103) | 330 (52.4) | 1960-1972 | | |
| #4 | 1D | | | | | | 820 (250) | 635 - 820 (194-250) | | 2530 (402) | 1961-1972 | | |
| #5 | 1E | | | | | | 820 (250) | 635 - 820 (194-250) | | 2080 (330) | 1961-1972 | | |
| Canadian #1 Industries Limited 2 Wells #2 | 5 | Lambton | Sombra | 15 | 2 | | 1249 (381) | 775 - 1234 (236-376) | 370 (2551) 100 ppm | 1200 (191) | 1968-1972 | 3,750,000 (596,202) | Steam Condensate with ammonia and $CO_2$ |
| | 6 | | | 15 | 4 | 607.5 (185) | 1239 (378) | 790 - 840 (241-256) | 370 (2551) | 1200 (191) | | | |
| Dow Chemical 2 Wells | 2A | Lambton | Sarnia | RR | 29 | | | Cavern, Saline Salt 1960' | 0 | | 1968-? | 4,000 (636) | Waste Oils Solid $CaCO_3$ Residue |
| | 2B | | | | 30 | | | | | | | | |

**Industrial Waste Injection Wells, Lambton County, Ontario.**




Location of disposal wells in part of Lambton County (From URM, 1984)

## 3. Historical and Present Quality of Water and Sediments and their Impact on Biota Along the Length of the St. Clair River

Heavy urban and industrial development and use as a transportation corridor have contributed to water quality impairment in the Great Lakes connecting channels including the St. Clair River. Although conventional water quality in these areas has improved since the 1960's, pollutants such as heavy metals and persistant organic compounds (e.g., OC Pesticides, PCBs) remain in the fish and sediment and water in amounts at times exceeding jurisdictional objectives or guidelines. A brief description of the nature of the problem is outlined in the table below (Water Quality Board 1985).

NATURE OF THE PROBLEM

| Types of Problems Encountered | Possible Sources of the Problems |
|---|---|
| Conventional Pollutants | Municipal Point Sources |
| Heavy Metals | Industrial Point sources |
| Toxic Organics | Combined Sewer Overflows |
| Contaminated Sediments | Groundwater |
| Biota Impacted | |
| Beach Closings | |
| Fish Consumption Advisories | |

Bacterial contamination from combined sewer overflows at Sarnia limits local recreational use.

Residual sediment contamination and, to a lesser degree, industrial discharges are slowing the recovery of the benthic fauna, adjacent to and downstream of the petroleum and petrochemical complex in Sarnia and Moore Township.

Trace organic contamination of water, sediment and fish identified but significance not known - studies proceeding.

Sediments in several locations along the Ontario shoreline of the St. Clair River remain contaminated with trace organics, PCB and heavy metals and require confined disposal if dredged.

### Water

The St. Clair River is subject to industrial discharges from refineries and petrochemical plants amounting to a total flow of 500 million gallons/day or 0.5% of the total river flow. Most of these discharges take place in the nearshore area where limited mixing is coupled with the build-up of contaminants due to multiple sources (about 20 direct outfalls to the river).

Total phenol levels along the Ontario shoreline are now within the 1978 Great Lakes Water Quality Agreement Objective. This compliance was achieved as a result of the introduction of biological oxidation units by most of the industries in their process streams prior to effluent discharge to the river.

The Ontario Ministry of the Environment intensive programs during 1982-84 indicated that chlorinated organics such as hexachlorobenzene (HCB), octachlorobenzene (OCB) were detected in parts per trillion levels in nearshore river waters. These compounds were found to persist along a 2-km reach of riverfront from the Township Ditch to the Dow/Suncor property line. Shell Canada and Petrosar Limited effluents have also contributed to the persistence of these compounds.

On occasion, concentrations of chlorinated contaminants have approached parts per billion levels and resulted in exceedances of proposed objectives or criteria for the protection of aquatic life. The magnitude of exceedance was up to 370-fold for HCB, 13-fold for HCBD and 5-fold for OCB. No transboundary pollution occurs from the Ontario discharges downstream as far as the river mouth delta. In the river delta, however, traces of these compounds occur in the South Channel where transboundary movement to the State of Michigan is prevalent. In this channel, contaminants such as HCB, are mainly associated with the water phase.

Environment Ontario's Drinking Water Surveillance Program (DWSP) indicates that no organic compounds have been found to exceed the Ontario Drinking Water Objectives or other health-related guidelines. Dibenzo-p-dioxins and dibenzofurans have not been detected in any form in any treated water samples.

Sediment

St. Clair River sediments are generally characterized by sand and gravel overlying a clay hardpan. Shoreline development such as landscaping and construction of docks and breakwalls in the mid 1970's have likely resulted in increased amounts of sand and crushed stone along the immediate riverfront of the Chemical Valley.

The Ontario Ministry of the Environment investigations in 1983 and 1985 indicated surficial sediment contamination with heavy metals (particularly mercury, although decreased significantly in recent years), PCBs (up to 3000 ug/kg), HCB (up to 600 ug/kg) and OCS (up to 580 ug/kg). Total chlorinated dibenzo-p-dioxins (CDD) and total chlorinated dibenzofurans (CDF) have been detected at levels of 5 and 22 ppb, respectively. No tetradioxins, nor 2, 3, 7, 8-TCDD were detected in these sediment samples.

These contaminants were found to be localized in a reach of 1.5 km length along the Polysar/Dow riverfront. Sediments in the vicinity of the Walpole and Wallaceburg water intakes contained relatively low levels of Octa - CDDs and Octa CDFs, no PCBs, but hexachlorobenzene levels ranged from 100-200 ppb.

During the 1977 St. Clair River Organics Study, oil globules were observed in the bottom sediments. These globules were attributed to spills from freighters, docked ships during cargo handling and industrial sources.

Using technology developed in 1984 and 1985, analysis of an oily layer above the sediment showed elevated levels of chlorinated organics (mainly tetrachloroethylene in ppm range). Total chlorinated dioxins in the 1985 samples amounted to an average of 35 ppb and the total chlorinated dibenzofurans averaged 81 ppb. This oily layer and associated contaminants were localized and confined to an area of 20 x 50 m in the vicinity of Dow Chemical.

The attached 2 tables provide data on: (1) sediments from the St. Clair River south of the CN tunnel (collected in 1984 by NWRI); and (2) results of the analyses of 1984 and 1985 samples of the oily layer off Dow.

Biota

Benthic community structure analyses by the Ministry of the Environment in 1968 and 1977 revealed the resurgence of bottom dwelling life forms along the Ontario shoreline of the river; however, there was a zone of severe impairment (5 km long x 78 m wide) along the chemical valley waterfront. During May 1985, an update of biological conditions of this area indicated signs of further improvements as evidenced by the presence of organisms indicative of good water quality. A repeat of this biological survey in November 1985 suggested that there was little change between seasons with the exception of a degraded area (20 x 50 m) in the vicinity of Dow's 1st Street sewer complex. The remaining portion of the river, as well as the entire U.S. shoreline, exhibited healthy benthic communities not affected by the industrial discharges.

Programs using clams introduced to the river in cages and collections of fish, such as the young-of-the-year spottail shiners, have confirmed the findings of water quality programs indicating that chlorinated organics are prevalent at elevated levels in a 2-km section of the waterfront from the Township Ditch to the Dow/Suncor property line. The caged clams data further reveal that the impact of upstream sources of PCBs, OCS, HCB, HCBD, QCB may extend as far as Port Lambton, 35 km downstream from the Chemical Valley.

The spottail shiners data indicate a decline of HCB levels from 406 ng/g (ppb) in 1979 to 6 ng/g (ppb) in 1983. Polycyclic aromatic hydrocarbon (PAH) residues in spottail shiners collected downstream from Suncor total 4.6 ng/g (wet weight whole fish) and the percentage of known or suspected carcinogens was about 42% of the total PAH level.

NWRI

**RIVER SEDIMENT ANALYSES FROM BOTTOM OF ST. CLAIR RIVER 1984**

| Parameter | No. of Stations Detected | Concentrations (ppb) Average | Range |
|---|---|---|---|
| Hexachloroethane | 8 | 18.9 | 0.028-43 |
| Hexachlorobutadiene | 11 | >5,532.0 | 0.99-40,000 |
| Pentachlorobenzene | 10 | 353.0 | 0.14-1800 |
| Hexachlorobenzene | 11 | >4,320.7 | 2.0-23,000 |
| Octachlorostyrene | 10 | 976.1 | 0.24-3,900 |
| Total PCB's | 11 | 3,559.9 | 2.0-14,000 |

## ST. CLAIR RIVER
## SLUDGE SAMPLE ANALYSES
## (1984 and 1985 samples)

i)

| Parameter | Concentration (ppm) 1984 | 1985 |
|---|---|---|
| Hexachloroethane | 1400 | 1,100 |
| Hexachlorobutadiene | 1100 | 1,600 |
| Pentachloropropene | 70 | 60 |
| Tetrachlorobutene | 40 | |
| Hexachloropropene | 170 | |
| Pentachlorobutadiene | 250 | 40 |
| Hexachlorobutene | 60 | |
| Tetrachlorobenzene | 50 | |
| Diphenyl Ether | 40 | |
| Pentachlorobenzene | 75 | |
| Hexachlorobenzene | 600 | 1,200 |
| 2,4-D(Ester Acid?) | 50 | |
| Dibutyl Phthalate | 360 | |
| N-Dichloromethyl-Pentachloroaniline | 80 | |
| Octachlorostyrene | 180 | 70 |
| Napthalene | | 170 |
| Pentachloropropane | | 19 |
| $C_4$ Biphenyl | | 13 |
| Methyl Phenanthrene | | 9 |
| Sulphur ($S_8$) | | 30 |
| Fluoranthene | | 14 |
| Pyrene | | 15 |
| $C_{16}$ $H_{13}N$ PAH | | 12 |
| Perchloroethylene | 35,000 | >100,000 |
| Chloroform | | 300 |
| 1,1,1-Trichloroethane | | 1,100 |
| Carbon Tetrachloride | | > 25,000 |

ii)

| Parameter | Concentration (ppb) 1984 | 1985 |
|---|---|---|
| Tetrachorodibenzofuran | 58.3 | 30 |
| Tetrachorodibenzodioxin | 18.3 | 32 |
| Pentachorodibenzofuran | 6.0 | ND* |
| Pentachorodibenzodioxin | 7.7 | 68 |
| Hexachorodibenzofuran | 14 | ND |
| Hexachorodibenzodioxin | 11 | ND |
| Heptachorodibenzofuran | 4.2 | 28 |
| Heptachorodibenzodioxin | 24 | ND |
| Octachorodibenzofuran | 260 | 28 |
| Octachorodibenzodioxin | 180 | 14 |

*ND - not detectable

Data obtained from the analysis of emerald shiners in 1985 at three locations in the St. Clair River (Blue Water Bridge control, downstream from Suncor and Stag Island) revealed no traces of tetrachlorinated dibenzo-dioxins. There was indication, however, that Lake Huron may be a source of tetradibenzofurans, since the control station indicated a level of 1200 ppt. Similarly, sport fish analysis revealed a level of 4 ppt of 2, 3, 7, 8-TCDD (with a maximum of 9 ppt) in channel catfish from Lake Huron.

The Ontario Sport Fish data base for the St. Clair River contains information on persistant contaminants such as mercury, PCB, mirex, organochlorine, pesticides and 2,3,7,8-TCDD. Consumption advisories on the data base are published in the "Guide to Eating Ontario Sport Fish".

At present, certain species and sizes are advised for limited or non consumption based on mercury (22 cases) and PCB (7 cases). No specimen tested exceeded (or in fact approached) the Canadian Federal tolerance of 20 ppt for 2,3,7,8-TCDD.

The advisories for mercury and PCB are presently less restrictive than in previous years due to declining levels of both substances. More recent samples of various species of sport fish were analyzed for hexachlorobenzene and octachlorostyrene. Low levels (ppb) of these compounds were found; health advisory levels for HCB and OCS are currently not available.

During July 1984 samples of the attached algae Cladophora were collected by the Ministry of the Environment from five shoreline sites in the St. Clair River bordering the industrial complex at Corunna (Shell Canada/Ethyl Corp. of Canada/Petrosar) and analyzed for heavy metals and PCBs (triplicate analyses). For comparison, a background control sample of Cladophora was also taken upstream of Sarnia. Results show the presence of a number of contaminants (i.e., nickel, selenium, barium, copper, chromium, manganese, lead, arsenic, mercury, PCBs) at levels above background in the vicinity of Corunna; and of these contaminants, point source loadings of selenium, lead, mercury, PCBs are indicated.

## 4. HAZARDOUS WASTE TRANSBORDER MOVEMENT IN THE SARNIA AREA

The majority of the hazardous waste entering the country at Sarnia is destined for the Tricil waste management facility in Corunna, 12 km southeast of Sarnia. In 1977 an estimated 2,400 cubic meters of imported waste was disposed of at Tricil. This volume has increased steadily to 22,000 cubic meters in 1984. The wastes disposed of at Tricil came from the U.S., 80% coming across the Blue Water Bridge at Sarnia.

The Tricil Corunna facility is comprised of a high temperature liquid injector incinerator and a controlled solid waste landfill. They are licenced by the Ontario Ministry of the Environment to receive oily water, acids, alkalis, waste oils, organic solvents, amines, glycols, other organics (except PCBs) and other inorganics, pigments, paints, printing and adhesive wastes.

The Ontario Ministry of the Environment have undertaken a computer search of waste movement records prior to 1977 to see if there were any discrepancies or unusual movements by Dow or other Sarnia companies. None were found.

Wastes moving internationally, interprovincially, or intraprovincially must be manifested, as of July 1, 1985, in accordance with the Transport of Dangerous Goods Regulations, and Ontario Regulation 309. The manifest system is a "cradle to grave" means of tracking wastes, with the responsibility placed on the generator for its ultimate disposal. There is also a prenotification requirement for wastes entering Canada. The nature of the waste and its destination must be identified by the generator in the prenotification which must be submitted annually.

International and interprovincial movement of wastes is federal responsibility under TDGA. Interprovincial movement is the responsibility of the province. Licensing of waste haulers is done by the province under agreement with Transport Canada.

Under TDGA all industries that offer hazardous wastes for Transport in quantities over 500 kg or in bulk must register every five years with the Transport of Dangerous Goods Office of Transport Canada.

REMEDIAL ACTIONS AND SCIENTIFIC STUDIES

1 Perchloroethylene Spill

- Dow Chemical spilled an estimted 9,400 gallons of perchloroethylene, of which 5,500 gallons were recovered from catch basins on Dow's property and from the river. Approximately 2,500 gallons reached the St. Clair River at Sarnia between August 13 and August 16. The estimate is based on MOE's modelling of the spill.

- On August 14, Dow Chemical found high levels of contaminants in a sample taken the previous day from one of its sewers which leads to the St. Clair River. The company informed MOE about the problem the same day.

- The company began a suction cleanup of the heavier-than-water liquid on August 16, and recovered about 5,500 gallons from the river sediment and sewer catch basins.

- MOE-Sarnia has advised local municipalities of its testing program and provided analytical results to local medical officers of health. Information has also been provided to the Michigan Department of Natural Resources, Health and Welfare Canada and Environment Canada.

- MOE concluded the investigation and on September 30 Dow Chemical Canada Inc. in Sarnia was charged with six counts under Ontario's environmental legislation. Dow pleaded not guilty to the charges and a trial date of January 15-16 was set for Sarnia Provincial Offences Court.

- Four charges (under Section 16(1) of the Ontario Water Resources Act) are laid for discharging perchloroethylene into the St. Clair River on four days during the week of August 12, 1985.

- Two other charges (under Section 13(1) of the Environmental Protection Act) are for causing harm and material discomfort to people as a result of the chemical spill.

- Raw water samples taken September 3 at Walpole Island and Wallaceburg contained 2-7 parts per billion perchloroethylene. The World Health Organization's tentative criteria for drinking water is 10 parts per billion. Nothing was detected in samples from Stag Island, Belle River, Windsor, and Amherstburg.

DOW CHEMICAL CANADA INC.
Vidal Street, P.O. Box 3030, Sarnia, Ontario, N7T 7M1

October 23, 1985

2. DOW'S PROPOSAL FOR REMOVAL OF ST. CLAIR RIVER SEDIMENT

1. Because there is visual evidence of perchloroethylene (PCE) trapped in the St. Clair River sediment near Dow's First St. area outfalls Dow proposes to remove the loose PCE contaminated sediment in this area.

2. The area of sediment removal is defined as a 150' X 150' area bounded on the east by Dow's seawall and on the north by an extension of our property line with Polysar. This area was defined by a visual inspection using divers. A rope grid is currently staked to the river bottom in this area. The 150' X 150' area includes the 30' X 100' low area of particular concern to the MOE. The average depth of sediment in this area is estimated to be 6" so approximately 450 cu. yds. of sediment will be removed.

3. Sediment will be removed by means of high powered vacuum trucks. One truck will be positioned on a stabilized barge in the river and another one on shore near Dow's Third St. outfall. Sediment will be sucked from the bottom through hoses into the truck and then transferred to a watertight Dinosaur bucket on a small transfer barge. The small barge will then be moved to the Third St. outfall area where the material will be removed from the bucket by the second vacuum truck. The end of the hose will have a special nozzle attachment and valve which will be operated by divers at the bottom.

   The job will be carried out working from north to south and east to west. Any large debris encountered (e.g., rocks, tree stumps) will be moved aside but not removed.

4. No downstream impact is expected. As an additional precaution during the sediment removal process a series of grab samples will be taken daily approximately 2 hours after the removal work has started. The samples will be taken approximately 3' from the bottom of the river at the following locations:

   1) one sample upstream of work area

   2) two samples approximately 1000' directly downstream from work area

3) three samples along a transect at Dow's south boundary with Suncor

4) one sample from the LIS # 8 station south of Courtright

The samples will be analyzed by Dow for perchloroethylene (LOD 0.1 ppb). The data will be assessed by Dow and the MOE prior to starting the next days work. The MOE will sample drinking water intakes downriver before and during the removal operation. Dow will analyze the samples for PCE. All samples will be subject to random crosschecks by the MOE lab.

The following criteria will be used for purposes of the monitoring programme:

a) 1-day-SNARL = 2300 ppb PCE. This level not to be exceeded at Dow-Sun boundary.

b) 10-day SNARL = 175 ppb PCE. This level not to be exceeded at the Dow-Sun boundary as an average daily concentration over the duration of the programme.

c) 70-yr. W.H.O. Criteria = 10 ppb PCE. This level not to be exceeded at any of the drinking water intakes.

5. Disposal of the removed sediment will be as follows:

a) Material from vacuum trucks will be stored in a clay-lined pond in Block 120 where it will be allowed to settle.

b) Clear water will be decanted and transferred by vacuum truck to Plant 35 for processing by CPEC.

c) The remaining solids will be stream-stripped to remove the PCE and then landfilled at Dow's Scott Road Landfill site. The PCE removed will be recycled through the CPEC system for recovery.

6. The estimated timing of this project is as follows:

a) The removal operation should take approximately two weeks subject to weather conditions.

b) Treatment of decanted water and sediment will take somewhat longer. It is estimated that 8 - 9 months may be necessary to process this material because of winter freeze-up.

c) The starting date is tentatively scheduled for October 28, 1985.

## Disposal of Dredged Material

MOE will be informed prior to commencing disposal of dredged material.

Water:

Water phase directed to Chlorinated Products Ecology column (CPEC).

Based on low solubility, no dioxin is expected in the water phase.

CPEC considered 98% efficient in perchloroethylene recovery. Water discharge from CPEC to sewer should be less than 2 ppm before dilution in sewer.

If water phase does contain dioxin, dioxin would strip with perchloroethylene which is directed to the chlorinated solvents reactor.

The dioxin fraction would become a component of the heavy tars generated in the reactor which are subsequently destroyed in the Thermal Oxidizer (TOX Unit) which is considered capable of destroying dioxin.

Sediment:

To be transferred by bucket to a steam stripper. Condensed volatiles from stripper directed to CPEC.

Dow is of the opinion that most dioxin will remain with solids rather than strip off.

Any dioxin which may be stripped with the perchloroethylene will go ultimately to the TOX unit as above.

Anticipated that perchloroethylene remaining in solids after stripping will be less than 1000 ppm.

Landfill:

Scott Road site is approved for chlorinated solids and hazardous materials.

Dioxin should not leach from solids. In the event it does, leachate treatment by activated carbon filter bed will control.

Ontario

Ministry of the Environment | Ministère de l'Environnement

Southwestern Region | Région du Sud-Ouest

985 Adelaide Street South
London Ontario
N6E 1V3
519/681-3600

985 sud, rue Adelaide
London (Ontario)
N6E 1V3
519/681-3600

-30-

November 8, 1985

Dow Chemical Canada Inc.,
Vidal Street,
P. O. Box 3030,
Sarnia, Ontario.
N7T 7M1

Attention: Mr. S. Bolt

Dear Mr. Bolt:

This letter will confirm the Ministry of the Environment's approval of your company's proposal of October 23, 1985 and the additions to it of November 5, 1985, for the removal of contaminated sediment on the floor of the St. Clair River adjacent to your company's property. This approval is subject to the procedures outlined in your proposal and the following conditions:

1. The procedures for removal of material from the river bottom, its transfer to the barge, its transfer from the barge to the vacuum truck, and its placement in the pond on Dow property be in accordance with requirements of the Ministry of Labour for protection of workers.

2. The sampling program during removal will be carried out as follows:

   (a) One sample to be taken 1000' upstream of work area at mid-depth 125' from shore.

   (b) At a transect 1000' downstream from work area samples will be collected at a lateral distance of 25', 125', 225' from shore and entail the following:

      (i) hourly sampling for suspended solids at the 1000' location (25', 125', 225' from shore) at surface mid-depth and sediment water interface.

(ii) Every two hours, starting one hour before work start up and for duration of the first three operating days, samples will be analysed for perchloroethylene at mid-depth and the sediment water interface. (A decision will be made on the sampling frequency and locations based on the results of the first three days samples).

(c) Three samples should be taken along Dow's south boundary with Suncor on a transect from shore at 25', 125' and 225'. These samples should be taken at the sediment water interface and at mid-depth. Samples should be taken 3 times/day (early morning, after start-up; mid-day and late afternoon). A decision will be made on the sampling program based on results of the first 3 days operation.

(d) One sample should be taken from LIS #8 station at Courtright (mid-depth).

3. The removal of material will stop at the direction of MOE if monitoring indicates the criteria have been exceeded or additional information is required by MOE.

4. Liquid level in the storage pond shall be maintained below ground level.

And recognizing the following actions will or have formed part of the clean-up project:

(1) A MOE diver will observe the clean-up work as it progresses.

(2) Temporary facilities for treating with powdered activated carbon installed at Walpole Island and Wallaceburg will be placed in operation during the test stages and should monitoring indicate the presence or likely presence of perchloroethyelene in the raw water supply the treatment would continue.

(3) Air samples will be collected at the storage pond to monitor air emissions.

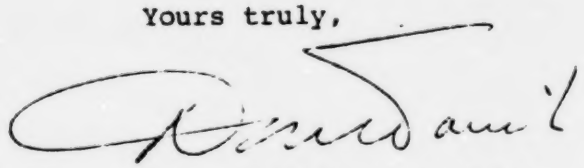
(4) Borehole results from the storage pond bottom have been assessed by the MOE hydrogeologist and confirm the integrity of the pond to contain the sediment material removed from the river.

(5) Information on the daily sampling will be provided to the MOH, municipalities and Michigan Department of Natural Resources. Communication with Michigan DNR (and the U.S. Environmental Agency) has been established for this project.

(6) Samples of raw and treated water will be collected at Wallaceburg and Walpole Island during the clean-up project.

The Ministry may require some changes or additional information as this work proceeds. Communication during every phase of the clean-up is important. In this regard, our contact person will be Mr. K. Haniff (336-4030) of our Sarnia Office. Back-up contacts should be obtained from Mr. Haniff.

Yours truly,



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D. A. McTavish, P. Eng.,
Regional Director.

## 3. St. Clair River Pollution Investigation

**Environment Canada**

OBJECTIVE

To comprehensively define the extent of contamination in a 3 km. reach of the St. Clair River, (on the U.S. and Canadian sides of the river), which presently exhibits 'tarry patches' of organochlorine waste and highly contaminated sediments.

PRIORITY ACTIVITIES

1. Collect sediment samples along 10 transects; 2 above the CN tunnel and 8 downstream. Transects below tunnel will be located on lines already established by the University of Windsor. Six sediments samples will be collected from each transect, 3 on each side of the river, for a total of 60 samples.

2. Water samples will be collected from 'deep holes' in the St. Clair River delta around Walpole Island. Preliminary evidence suggests these could be deep groundwater sources (karst springs).

3. Collect samples from 18 to 20 industrial effluent point souces on the Canadian side of the St. Clair river, within the 3 km. stretch south of the CN tunnel.

PARTICIPANTS

Environment Canada

- Office of the Regional Director General
- National Water Research Institute
- Environmental Protection Service - Ontario Region

Work Schedule (tentative)

| | |
|---|---|
| Sampling: | November 3 to December 2, 1985 |
| Analyses: | December 2 to December 16, 1985 |
| DOE Report: | December 20, 1985 |

Ongoing Activities (coordination and consultation with)

1. University of Windsor, Great Lakes Institute, hydrogeological studies of groundwater seepage into the bottom of the St. Clair River.

   Contact: R. Patterson (NHRI)

2. St. Clair River water column sampling and analyses.

   Contact: B. Oliver (NWRI)

3. Suficial river water analyses for volatile organic industrial effluents.

   Contact: K. Kaiser (NWRI)

4. Underwater video photography along University of Windsor transects in the vicinity of the previously observed 'tarry patch'.

   Contact: K. Rodgers (NWRI)

5. Co-ordination with ongoing MOE investigations of sediment, water and benthos.

   Contact: F. Fleischer (MOE)

PROVINCIAL (MINISTRY OF THE ENVIRONMENT) CURRENT STUDIES

- Surveys of (May '85, Nov. '85) St. Clair River benthic fauna and sediments to assess improvements due to remedial measures and impacts of chemical spoils.

- Sept. 23-28/85 intensive survey downstream of Dow Chemical to identify impact of tetrachloroethylene spill on water, sediments, biota.

- Development and testing of a fate model using a typical organic compound discharged into the river to discern concentrations in sediments, water and biota.

- 1984 and 1985 survey of tributary inputs of trace contaminants.

- Report on bacterial conditions along the Sarnia waterfront, assessing impact of developments at Sarnia Bay on the dispersion of discharges from storm and combined sewer overflows.

- Report on 1983 sediment and benthos survey in Lake St. Clair.

- Analyze 1984 sampling of trace organics and 1984 clam biomonitoring.

- Investiage industrial and municipal sources and quantify loadings of contaminants of existing or potential concern at major facilities in the connecting channels and Lake St. Clair.

- Investigate non-point sources of pollution in the study area watershed to quantify by source type the loadings of contaminants of concern reaching the connecting channels and Lake St. Clair from tributaries.

- Stratified water quality sampling at 2 major tributaries (Sydenham River, Thames River) for annual nutrient and contaminant loading estimates.

- In-place Pollutants Program: Survey sediments, benthic organisms and sculpins to determine impacts of contaminants in sediments on water quality and aquatic biota; benthic surveys to determine toxicity of contaminated sediments on aquatic biota; reporting on 1984 sediment and macrozoobenthic surveys to asses the impact of in-place pollutants on several groups of macroinvertebrates and seasonal variation in contaminant body burdens.

- Collections of young-of-the-year spottail shiners from 10 localities for point-source identifications, assessment of effectiveness of remedial measures, temporal trend assessment.

- Ontario Drinking Water Surveillance Program. Monitoring of inorganic and organic contaminants (6 times per year) at raw, finished and distribution system locations.

- Sampling of raw water from 3 municipal intakes (at Sarnia, Amherstburg, Kingsville) to monitor long-term trends relative to phosphorus removal programs.

- Sportfish Contaminants Surveillance for development of Consumption Guidelines. Collection consists of edible portions from 257 adult fish. Collection also at Lake St. Clair and Southern Lake Huron.

5

# EXECUTIVE SUMMARY OF THE UGLCC WORK PLAN

## BACKGROUND

The Upper Great Lakes Connecting Channels consists of four navigational waterways. The St. Marys River connects Lakes Superior and Huron. The St. Clair River and Lake St. Clair flow into the Detroit River, connecting Lake Huron and Lake Erie. Heavy urban and industrial development, and the use of the channels as transportation corridors through one of North America's great inland waterways, have contributed to water quality degradation in these channels. Pollution problems, including mercury contamination in Lake St. Clair and phenols in the St. Marys River, were recognized in these areas as early as the 1940's. The designation of the St. Marys, St. Clair and Detroit Rivers as class A areas of concern by the International Joint Commission (IJC) in 1981 was based on evidence of significant environmental degradation and severe impairment of beneficial uses. Although water quality in these areas has improved, persistent pollutants such as heavy metals, organochlorine pesticides and PCBs remain in the fish, sediment and water.

In his November 1983 speech to the IJC meeting in Indianapolis, Indiana, the U.S. Environmental Protection Agency Administrator William Ruckelshaus announced a U.S. study on the St. Marys, St. Clair and Detroit Rivers, including Lake St. Clair, and invited Canadian support. By February 1984, the State of Michigan, Environment Canada, Department of Fisheries and Oceans, and the Ontario Ministry of the Environment had all agreed to merge their ongoing studies and develop new programs in conjunction with the U.S. agencies. The City of Detroit, also having ongoing studies, subsequently joined the effort. Since then the research and environmental laboratories of the various Canadian and U.S. regional and federal agencies plus those of several universities, are committed to providing the necessary support to determine the sources, fate and impact of toxic contaminants released to the connecting channels.

## STUDY PURPOSE

The purpose of the Study is:

1) to facilitate the development of remedial action plans; and

2) develop a framework for long term understanding of ecosystem-contaminant dynamics for these waterbodies.

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While considerable progress has been made in the control of pollution in the Upper Great Lakes Connecting Channels (UGLCC), these areas continue to be designated as Areas of Concern by the International Joint Commission (IJC). To identify and address the remaining problems in these geographic areas, Canadian and U.S. environmental agencies have agreed to embark on a three year study of the St. Marys, St. Clair and Detroit Rivers, and Lake St. Clair. The study will evaluate historical and current scientific data, augmented as necessary by coordinated surveillance and research efforts to identify and quantify the impacts of conventional pollutants and toxic substances from point sources, nonpoint sources (both runoff and contaminated groundwater) and tributaries on beneficial human uses. The resultant data will be used to recommend specific actions to address remaining and emerging concerns. These recommendations will provide guidance for the sponsoring agencies in their development of programs for management of pollution controls and for long term monitoring of the effectiveness of these programs.

STUDY AREA

The study area includes St. Marys, St. Clair River, Lake St. Clair, the Detroit River and the Western Basin of Lake Erie as it relates to impacts from the Detroit River. The tributaries to the above system will be considered as part of the study area if their individual study is needed to accurately define specific sources and effects of contaminants. In the case of contaminated groundwater and associated waste sites, the study will be limited to those areas having present or potential impact on the water quality of the study area.

PARTICIPANTS AND MANAGEMENT STRUCTURE

The study will be conducted jointly by agencies of the Federal governments of the United States and Canada, the State of Michigan, and the Province of Ontario. The study is directed by a three-tiered management structure: the Management Committee, the Activity Integration Committee and the Study Work Groups.

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The Management Committee consists of representatives of the principal U.S. and Canadian agencies participating in the study. These include the U.S. Environmental Protection Agency (EPA), Michigan Department of Natural Resources (MDNR), U.S. Fish and Wildlife Service (FWS), National Oceanic and Atmospheric Administration (NOAA), U.S. Army Corps of Engineers (COE), City of Detroit, Canadian Department of the Environment (DOE), Department of Fisheries and Oceans (DFO), and the Ontario Ministry of the Environment (OMOE). The responsibility of the Management Committee is to identify the issues and define the study structure, approve the study work plans, and approve the final study report for submittal to the participating agencies.

The Activity Integration Committee (AIC) consists of the chairmen of the technical work groups plus representatives of U.S. and Canadian federal and regional governments. It is responsible for preparing and overseeing implementation of the study work plan and the drafting of the final study report.

Members of the work groups are scientific technical experts from participating governmental agencies. They have major responsibilities for identifying, planning and coordinating the surveillance and research activities.

## SCHEDULE

This project will proceed in several stages: planning and organization, 1st field year, 2nd field year, and report preparations. The planning and organization activities were begun in early 1984, the completion of data collection and analysis is anticipated at the close of the 1986 field session, and the final report will be delivered to the sponsoring agencies in the Fall of 1987.

## APPROACH AND ACTIVITIES

In order to meet the objectives and goals of the Upper Great Lakes Connecting Channels Study, 68 activities have been proposed and grouped into 8 general categories. These are: point sources, nonpoint sources, water quality, sediments, biota modeling, data quality management and administrative support.

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Because the focus of the UGLCC Study is to define remaining needs for regulatory and remedial actions, the activities to be implemented within the Study reflect the two broad categories of concern: toxic contamination and habitat destruction. The study will address problems of continuing inputs and of in-place pollutants (i.e. contaminated sediments). Activities will assess the relative contribution to contaminant problems from industrial and municipal point sources, from agricultural and urban runoff, and from selected combined sewer overflows. Contaminated groundwater and hazardous waste sites that should receive further study will be identified. In-place pollutants, i.e., those associated with sediments, may represent a source for downstream loadings, and their contribution to the overall problems will be evaluated.

Estimates of loading of contaminants will be made as well as an identification of the nature (chemical and species) and location of the problem. As new problems are identified and better understanding is gained of the existing situation, the information will be relayed to appropriate agencies for follow-up.

Habitat evaluations are needed to define both the problems and the solutions for maintaining the UGLCC for the highest attainable use. Destruction of habitat results from physical alterations as well as toxic influences. To bridge between toxic contaminants and habitat evaluations, some activities will identify and quantify ecosystem indicators and processes. These studies will assist in the interpretation of how contaminants have affected habitat and will also assist in the setting of priorities for subsequent remedial actions.

The modeling output will be a mass balance model for contaminants that can be used as a management tool to assess the effectiveness of implemented remedial actions. Gross mass balance calculations for selected contaminants will also be made for the St. Clair and Detroit Rivers to determine if these areas act as a net source or sink for the compounds.

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Intensive studies will be implemented on small segments of the UGLCC stystem, including mass balance determinations in the Trenton Channel area of the Detroit River, biological effects of in-place pollutants in the Detroit River, and hydrodynamic studies of the St. Clair and Detroit Rivers and of Lake St. Clair. The results of these special investigations will contribute to a comprehensive understanding of physical, chemical and biological processes that should be incorporated into more general environmental models for the overall study area.

July 19, 1985

C. CONCLUSION

1. Clean-up of Dow Chemical's perchloroethylene spill is currently under the direct supervision by the Ontario Ministry of Environment. Environment Canada is providing technical advice and support as required. As a further precaution, the Joint Contingency Plan under the 1978 Great Lakes Water Quality Agreement was used to notify Canadian and U.S. agencies. MOE has taken precautionary measures in safeguarding drinking water supplies of downstream municipalities by distributing activated carbon powder for use in the treatment process throughout the clean-up operation. Also MOE is undertaking intensive water quality monitoring in river downstream from the site. Technical experts from Michigan Department of Natural Resources and U.S. Environmental Pollution Agency have been fully consulted and are on-site as observers prior to and during the clean-up operation.

2. Environment Canada is proceeding to carry out a short (6 week) intensive investigation to determine the extent and sources of pollution to a 3km reach of the river directly downstream of the Canadian National Railroad tunnel in Sarnia. This study consists of three parts including a sediment survey, characterization of industrial effluents, and examination of selected karst holes in the river bottom as possible sinks or sources of polluted material.

3. Upper Lakes Connecting Channel Study

   A four party (Environment Canada, Environment Ontario, Michigan and U.S. EPA) study of the Detroit, St. Clair and St. Mary's Rivers is currently underway. This study began in 1984 as a joint effort designed to define the sources and environmental effects of pollution to those interconnecting channels. Jurisdictions have undertaken this study as the basis for Remedial Action Plans to be developed to address these Areas of Concern for submission to the International Joint Commission in the continuing implementation of the 1978 Canada-U.S. Great Lakes Water Quality Agreement. Also this study will capitalize on activities previously mentioned in this report.

**ESSO PETROLEUM CANADA** APPENDIX I

- Located in Sarnia, this petroleum refinery discharges directly to the St. Clair River. The company has met ministry Petroleum Refineries Effluent Concentration Guidelines.

- In 1970, one Control Order was issued to the company for controlling hydrocarbons to the atmosphere, hydrocarbon were successfully controlled. Esso modified its fuel composition to meet Ontario Regulation 151/81 for sulphur dioxide emissions to the atmosphere. Regulation 151/81 is a special regulation used in Chemical Valley for the stringent control of $SO_2$ levels.

- Storm water from the Esso site contains phenolic compounds and is a danger to aquatic life. Esso treats storm water in an on-site industrial treatment plant (BIOX). The company has never been prosecuted but has received two violation notices issued in 1984 for failure to operate its BIOX in an environmentally acceptable fashion.

**PETROSAR LTD**

- Petrosar Ltd., a petroleum refinery located in Corunna, discharges effluent directly to the St. Clair River. The discharge quality meets the ministry Petroleum Refinery Effluent Concentration Guidelines except for phenols.

- Phenols, which are toxic to aquatic life, continue to be a problem and are due to BIOX plant upsets. The company is making improvements to the BIOX system.

- There have been no Control Orders issued to Petrosar Ltd. but one was proposed concerning smoky flaring. The Order was dropped after the company proposed and installed a $6 million abatement program.

- The company has never been prosecuted and is in compliance with Regulation 151/81 concerning sulphur dioxide in Chemical Valley.

**ESSO CHEMICALS CANADA LTD.**

- Located in Sarnia, Esso makes plastic resins and discharges its effluent directly into the St. Clair River.

- Esso's discharge meets ministry Industrial Effluent Concentration Guidelines and the company complies with the federal Vinyl Chloride Emission Regulation. However, there have been vinyl chloride emissions that have been reported to the federal government.

- A Control Order was issued in 1973/74 requiring treatment of wastewater to control organics which are toxic to fish. The company has complied with the order. Esso has never been charged by the ministry.

**SHELL CANADA LTD.**

- Located in Corunna, the refinery discharges to Talford Creek and then into the St. Clair River.

- The company's discharge quality met the Ministry's Petroleum Refinery Effluent Concentration Guidelines.

- A Control Order was issued in 1971 to control hydrocarbons to the air. The Order was met. A Program Approval was issued in 1981 for the company to meet Ontario Regulation 151/81 for the control of sulphur dioxide in the Chemical Valley area.

- There have been no prosecutions against the company but a violation notice was issued in 1985 for failing to comply with the conditions on the landfill Certificate of Approval.

**POLYSAR LTD.**

- Located in Sarnia, the company makes synthetic rubber and discharges effluent directly into the St. Clair River.

- The discharge quality met all ministry requirements set out in a Requirement and Direction (R&D) issued in 1977. A $25 million BIOX plant began operaton in 1983 and brought the company in compliance with the R&D. The 1979 St. Clair River Study identified high levels of benzene coming from the plant. Since the start up of the BIOX most benzene has been removed before entering the St. Clair River.

- Polysar was convicted in 1978 for a spill into the river and was fined $5,000.

**FIBERGLAS CANADA INC.**

- Located in Sarnia, the company manufactures glass wool insulation and discharges effluent into the Cole Drain which flows into the St. Clair River.

- The company's phenol discharge exceeds the ministry's guideline and the company has been fingered as the source of process water spills, which are currently under investigation.

- The Ministry has received numerous air pollution complaints about this industry. A Program Approval was issued in 1973 for air particulate. An investigation of the industry is underway in anticipation of issuing another Control Order for particulate some time in 1985. The company has never been prosecuted by the ministry.

**ETHYL CANADA INC.**

- Located in Corunna, the chemical manufacturer discharges effluent directly to the St. Clair River.

- The company does not meet the ministry's new target for lead. Excessive levels of chlorinated volatile organics have been identified in the final effluent and the company has been requested to find the source and to control the discharge. A Control Order may be required to complete this remedial action.

- There have been no prosecutions or orders issued on the company.

**DUPONT CANADA INC.**

- Located in Corunna, this compnay manufactures plastic resin and discharges directly to the St. Clair River.

- The company meets ministry Industrial Effluent Concentration Guidelines.

- The company has never been prosecuted nor been placed under Control Orders but at one time experienced a noise problem that has since been rectified.

**DOW CHEMICAL CANADA INC.**

- Located in Sarnia, the chemical manufacturer discharges effluent directly to the St. Clair River.

- The company has identified occasional levels of benzene, styrene and ethyl benzene in its effluent and will require additional control to reduce these levels. The company is currently investigating appropriate controls.

- Levels of hexachlorobutadiene and hexachlorobenzene in one sewer have resulted in levels in the river that exceed World Health Organization desirable concentration of 10 parts per trillion. The company is investigating further controls.

- Controls were issued on the company in 1971 and 1972 for emissions to the atmosphere, including chlorine.

- A condition was put on the company to monitor for trace organic compounds and the company has an action level of one part per million for total organic compounds.

- The company has installed abatement equipment to meet the federal Vinyl Chloride Regulation.

- Dow controls landfill leachate by carbon treatment.

- The company was charged with six counts under Ontario's environmental legislation in September, 1985 for a spill of perchloroethylene into the St. Clair River in August, 1985.

**CANADIAN INDUSTRIES LIMITED**

- Located in Courtright, this fertilizer producer discharges effluent directly into the St. Clair River.

- The company discharge quality met the ministry's Industrial Effluent Concentration Guidelines.

- A phosphate plant is to be closed in 1986/87 eliminating the need for gypsum ponds which produce radiation and fluoride. The ponds will be treated and capped.

- A control Order for the control of fluoride to the atmosphere was issued in 1970. Vegetation studies indicate elevated but not excessive levels of fluoride off company property. The company has never been prosecuted.

**UNION CARBIDE CANADA LTD.**

- Located in Corunna, this manufacturer of plastic resins puts its effluent discharge directly into the St. Clair River.

- Its discharge quality meets the ministry Industrial Effluent Concentration Guidelines. There have been no Control Orders or Prosecution of Union Carbide.

**SUNCOR SUNOCO GROUP**

- This petroleum refinery located in Sarnia puts effluent directly into the St. Clair River.

- Its discharge quality meets the ministry's Petroleum Refinery Effluent Concentration Guidelines, but does not meet the federal Guidelines for Petroleum Refineries. Instead of a Control Order to correct this situation, a condition on the Certificate of Approval for its $350 million Hydrocracker Complex required the company to expand the biological treatment plant to improve plant effluent by November, 1986.

- A Control Order was issued to the company in 1971 for the control of hydrocarbons. The company has never been prosecuted but was issued a violation notice in 1985 for failure to comply with a condition on the landfill Certificate of Approval.

- The company is in compliance with Regulation 151/81 for sulphur dioxide emissions into Chemical Valley. All storm water from the company's tank farm is directed to the company's treatment plant to remove phenols which are toxic to aquatic life.

**CABOT CARBON**

- The company located in Sarnia produces carbon block and discharges to the St. Clair River via the Cole Drain.

- Storm water exceeded discharge criteria but the company has since installed a treatment device and now meets ministry criteria.

- The company has a periodic particulate problem. MOE has requested the company to install monitoring equipment designed to eliminate bag house failure which is the root of the problem.

- No Control Orders have been issued on the company and they have never been prosecuted.

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